THE MURIDS AND SMALL DASYURIDS IN TASMANIA

PARTS 5, 6 AND 7

by

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PART 5. *Antechinus swainsonii* (Waterhouse, 1840)

ABSTRACT

The Tasmanian subspecies of Swainsons phascogale *Antechinus swainsonii swainsonii* was collected as part of a study of small mammals conducted during 1963, 1964 and 1965.

It was found to be confined principally to the western half of the island, with only isolated populations in the eastern half, and to be dependant upon the occurrence of beech *(Nothofagus cunninghamii)* rainforest. In this habitat and in the ecotonal periphery it was relatively common and taken in association with the indigenous velvet-furred rat *Rattus lutreolus velutinus* and long-tailed rat *Pseudomys higginsi*. It was found to shun the treeless areas of buttongrass *(Mesomelaena sphaerocephala)*, where it is replaced by the little phascogale *A. minimus minimus*.

Males exceed females in body proportions by a significant factor. Development is slow and breeding may commence before skull ossification is complete. The heaviest male collected weighed 90 gm. and the heaviest female 55 gm.

Insects form the greater part of the diet but larvae, earthworms and small vertebrate animals also are eaten.

Females may be carrying pouched young from early October to December, eight being the normal litter though a number in excess of the nipple complement might be produced. The young are born with well developed, sharp claws on the front feet but, soon after attachment to the nipple, the claws lose their sharpness and become less prominent.

Trapping in selected habitat during autumn and winter produced about one *A. s. swainsonii* to 25 trap-nights, with no obvious bait preference. Many catches appeared to result from the animal's inquisitive nature. Best results were achieved from February to July when populations are at their peak.

Some ectoparasites have been collected and determined. *A. s. swainsonii* appears to be relatively free from predation except in the ecotonal regions and its preferred habitat is secure in the foreseeable future.

DISTRIBUTION

Sample trappings has shown *A. s. swainsonii* to be widely distributed in Tasmania (see map, figure 11) and that it occurs principally in association with rainforest. The western half of the island supports the greatest populations and it has been taken at altitudes ranging from about 1000 metres to sea level. The shaded portion of figure 11 which illustrates the probable distribution of *A. s. swainsonii* is based on the occurrence of its preferred habitat.

Within this range there are considerable areas of button grass sedgeland which occur as clearings in the rainforest and, as these vary greatly in extent and distribution, it has not been practicable to define the precise limits. The map thus is intended to show the general range only but it may reasonably be assumed that more than half the indicated area supports rainforest in which *A. s. swainsonii* occurs. The isolated occurrences in eastern Tasmania are also associated with rainforest which, in some instances, are relatively small relict-like areas.

In the course of this study *A. s. swainsonii* has been collected from areas near Cradle Mountain, Waratah, Corinna, Renison Bell,and Mount Barrow. In addition the Queen Victoria Museum holds single specimens from Kindred (collected on 9.VII.1924), Fingal (12.X.1940), Royal George (4.IX.1969) and a desiccated carcase collected from Snowy Range, west of Huonville, in February 1967. The Tasmanian Museum holds two specimens collected at St. Valentines Peak in July 1962. N. A. Wakefield collected a single specimen at Molesworth on 21.I.1962 (Wakefield and Warneke 1963).

Guiler (1960) records it from Maydena, Orford, Nietta, Lake St. Clair, Dromedary Range and Sandy Bay (Hobart suburb). Wakefield and Warneke (1963) record it from near the mouth of the Arthur River and on Tasman Peninsula. They also record the existence of five specimens in the British Museum which were collected at Magnet (near Waratah), Henty River and Table Cape. The last named locality has been cleared for intensive farming for some years and it can be assumed that the species no longer exists in the area.

A. s. swainsonii material was found among the sub-fossil bone deposits in a limestone cave at Flowery Gully (Gill 1968). Trapping in this area has failed to catch this species or the endemic *Pseudomys higginsi*, with which it commonly occurs and which is also present in the Flowery Gully bone deposits. The present habitat in the area is not consistent with that in which the animals are usually found but there is a small reserve of relict rainforest (which is also a fauna sanctuary) a few miles to the south-west (see map, figure 11) where these species probably still live.

HABITAT

The rainforests (see part 3, plate 8) and adjacent ecotone are the preferred habitat of *A. s. swainsonii*. Their composition is variable and dependant upon

numerous factors such as soil fertility, aspect and frequency of fire. Jackson (1965) discusses these influences and their effect on the rainforest and ecotone. In many areas *Nothofagus cunninghamii* (beech) is the dominant tree, with *Atherosperma moschatum* (sassafrass), *Eucryphia lucida* (leatherwood), *Phyllocladus rhomboidalis* (celery-top pine) and *Anodopetalum biglandulosum* (horizontal scrub) occurring in varying abundance. In areas which have been subjected to periodic fires the dominant forest canopy is *Eucalyptus* spp. The understorey also varies considerably in density and composition and includes *Olearia argyrophylla* (musk), *Pittosporum bicolor* (cheesewood), *Drimys lanceolata* (native pepper), *Persoonia gunnii* (Gunn's persoonia), *Anopterus glandulosa* (laurel), and *Dicksonia antarctica* (soft tree-fern), the latter often being dominant in the gullies.

Throughout these forests, especially in the beech-dominated fire-free areas, there is a heavy accumulation of litter and rotting timber on the forest floor. This is often covered with a thick mat of wet green moss. Such accumulations form a labyrinth of natural cavities underground in which the animals hide and rest. Additional excavations in the rotting logs and stumps can be easily effected.

Firing has removed much of the debris from the ecotonal areas and populations are primarily dependant for shelter on the density of regrowth. The composition of this habitat is also very variable and patchy but in the western highlands it usually includes *Mesomelaena sphaerocephala* (button grass), *Ghania trifida* (cutting rush), *Sprengelia incarnata* (swamp heath), *Epacris gunnii* (Gunn's heath), *Monotoca* sp. (broom heath), *Boronia rhomboidea* (diamond boronia), *Leptospermum* sp. (tea-tree), *Gleichenia alpina* (dwarf coral-fern), stunted *Casuarina dystyla* (oak), stunted *Eucalyptus gunnii* (cider gum), *Poa caespitosa* (tussock grass), *Calorophus lateriflorus* (spreading rope-rush), *Restio australis* (mountain cord-rush), and *Lepidosperma filiforme* (common rapier-sedge). This scrubby ecotone habitat usually gives way to exposed treeless areas of wet sedgeland dominated by button grass into which *A. s. swainsonii* rarely ventures.

Climatic conditions vary considerably, with annual rainfall exceeding 250 cm. in much of the western habitat but in some of the isolated eastern areas it is only half this figure. Temperature likewise varies from minima as low as -12°C. in the subalpine habitat to maxima near 35°C. on the coast. The subalpine habitat is subjected to annual winter snow falls which may be up to 30 cm. deep for weeks at a time. In the forest areas the dense canopy and heavy litter afford some protection from the snow blanket but, in the ecotone habitat, the island-like nature of the vegetation results in the connecting runways across exposed areas being enveloped and heavy snow falls may cause local isolation. Trapping examination in areas under such conditions near Cradle Mountain in June 1966 showed *A. s. swainsonii* to be present in both the rainforest and the relatively more exposed ecotone and gave the impression that, though it remains active, it does not habitually leave the shelter provided in the microhabitat beneath the snow covered vegetation. Collecting has shown it to occur in the same habitat as the endemic Tasmanian pseudo-rat *P. higginsi* (see Part 4) and it is usually caught when trapping for that species but it is not so selective in its habitat preference and may occur in ecotone not normally favoured by *P. higginsi*. None were taken in the treeless expanses of button grass (*M. sphaerocephala*) where its place is taken by *A. m. minimus*.

The isolated occurrences plotted on the distribution map (see figure 11) may at first appear somewhat removed from the normal range of habitat but such instances invariably are found to be associated with small patches of relict rainforest.

DESCRIPTION

Findlayson (1958) gives a description of *A. swainsonii* based on 16 specimens

collected from Cradle Valley. Wakefield and Warneke(1963) give a description of *A. swainsonii* together with a range of tables showing body and skull proportions and tabulated comparisons of species, sub-species and samples from geographically different populations. They demonstrate that the nominate Tasmanian form is distinct subspecifically from that of the mainland Australian *A. s. mimetes*. The small number of Tasmanian specimens available at the time of their study now has been extended and the present description is based on a series of 30 skins and associated skulls and seven spirit specimens held in the collections of the Queen Victoria Museum. These have been assembled in the course of field studies conducted from 1963 to 1966 and were collected principally in the central north-western region.

External characters

In general form (see plate 20) *A. s. swainsonii* is stout with relatively large hind quarters and a small thoracic region. The neck is broad and the facial features sharp with the nose long and evenly tapered to the small, naked, dark grey nostrils. The ears are short, well rounded and when folded forward reach to the eyes. They are covered posteriorly and on most of the anterior surface with very short inconspicuous brown hairs. The anterior surface of the lobe region normally carries a tuft like cluster of hair considerably longer than that on the rest of the ear. The eyes are relatively small with the iris dark brown and the pupil black and are set in the sides of the head, slightly behind the mid-point between the nostrils and the ear. The legs are short and the soles of the feet broad. The upper surface of the feet is covered with short brown hairs. The toes are well articulated and the front feet dexterous. The claws are elongated and sharp, expecially on the front feet and generally lack pigmentation. The first digit of the hind feet lacks a claw and terminates in a naked dark grey pad. The toes of the hind feet carry a few prominent hairs which erupt near the base of the claw and may reach to the claw tip. These are absent or inconspicuous on the toes of the front feet. The under surface of the feet vary from pale grey to a dirty white, but the manus us usually paler than the pes. These are described and illustrated by Findlayson (1958) and Wakefield and Warneke (1963).

The manus is mostly dirty white with the pads showing a slight grey pigmentation. There are four interdigital pads, the inner member of which is considerably larger and more elongated than the remaining three and extends to the inner metacarpal. A prominent outer metacarpal is also present. The digital formula is 3>4>2>5>1. There are usually four elevated digital rings beneath each toe but this number may be reduced or indistinct on digit one and digit five.

The pes often appear pale grey in colour as the granulation, pads and digital rings are more noticeably pigmented than in the manus. There are four interdigital pads and an outer and an inner metatarsal. The first interdigital pad and outer metatarsal pad may or may not be joined, partly or completely, in either or both feet. The digital formula is 3>4>2>5>1, with the first being greatly reduced. There are four digital rings beneath the first toe and seven beneath the remainder.

The tail is slightly shorter than the head and body (see table 19) and is gently tapered. In some individuals it appears stout but in others, especially subadults lacking condition, it may be more slender and the caudal vertebra prominent. The tail scales are grey and arranged in about 180 irregular rings with about 25 scales to each ring in the basal region, decreasing to 20 per ring in the mid-region and 10 in the distal region. The tail is covered for most of its length with short bristle-like hairs occurring in sets of three which originate from behind each scale and are arranged in line between the rings. The centre member of each set is considerably longer than the laterals. They are directed acutely towards the distal end and are dark grey on the dorsal surface and pale grey

ventrally. Near the base of the tail they have a terminal or sub-terminal band of light tan brown. They are shortest in the mid region, reaching to 3 mm. and on the distal end may increase to 5 mm. About 10 mm. of the extreme basal region of the tail is clothed in soft fur similar to that of the body.

Nipple complement may vary from six to eight. Wakefield and Warneke (1963) give the nipple complement of *A. s. swainsonii* as six, based on the only four specimens in which development was sufficient to permit a count. Of 22 females handle by the present author, six were found to possess six nipples, four possessed seven and five possessed eight. The remaining seven were insufficiently developed. The nipples are normally arranged in line on either side of the pouch but in one instance six were normally positioned and a seventh was midway between the two most anterior members. The pouch is small and inconspicuous in subadult females but becomes greatly distended in an adult carrying young. The opening is from the rear but the pouch lacks depth and consists primarily of two lateral skin folds. The scrotum is pendulous and clothed in fur similar to that on the rest of the ventral surface.

Pelage

Sexual dimorphism is not apparent in the pelage. The fur is soft, very dense and relatively short. When brushed from rump to head it does not part readily but retains a dense, matted appearance. Its length is fairly even over most of the dorsum and on the flanks, where it reaches to 12 mm. on fully furred animals, but on the ventrum it rarely exceeds 9 mm. The guard hairs are not conspicuous and reach to 6 mm. above the main pile of the dorsum and flanks but are of lesser proportions on the ventrum and points. Those of the dorsum taper to a fine point and are a lustrous black, coarse and stiff in their terminal half but the basal half is much finer, less robust and a grey colour. Those on the ventrum are less bold and possess an off-white terminal band.

The main body pile is leaden grey for most of its length. On the dorsum there is a sub-terminal light tan band with the extreme tip black. On the flanks the black tip is absent and the terminal region is entirely light tan. On the ventrum the terminal region becomes very pale to off-white.

The composite effect is dark brownish grey dorsally, being greyer on the head and shoulders and slightly more browner on the rump and near the base of the tail. The flanks are slightly paler and the ventrum appears pale grey.

Lyne and McMahon (1951) give some details of the surface structure of the hair. The mysticial vibrissae vary in their conspicuousness between individuals. In some they may be as long as 25mm. while in others they may not exceed 10 mm. They are tapered over their entire length and are brown in colour, being dark in the basal region and paler terminally. The posterior members are longest and may be five times that of the anterior members. Several genal vibrissae are usually present, reaching to 20 mm. and usually very pale to off-white in the terminal region. Several supra orbitals may reach to 15 mm., two to four very pale interramal to 12 mm. and about four ulna carpals to 15 mm. Lyne (1959) gives further detail based upon five specimens two of which (X445 and X446 of his own collection) came from Maatsuyker Island. This is apparently an error of determination as the only *Antechinus* sp. known from that island is *A. minimus*.

Plastic Dimension

Plastic measurements were taken as follows:

Total length: From the tip of the nose to the tail tip, measured dorsally with the animal on its back.

Tail: From the base of the tail to the tip, excluding fur, measured dorsally with the tail turned back at 90° to the back.

Ear: From the tragoid notch to the ear tip.

Pes: From the back of the heel to the extremity of the longest (third) toe, excluding the claw.

The statistical details given in table 19 refer to adult or nearly adult animals with fully erupted teeth. This required the exclusion of five males and eight females collected in the months of February, March, April and June. Table 19 demonstrates that, on the average, males considerably exceed females in body weight and size, but that there is no significant sexual dimorphism if the length of the tail, ear or pes are expressed as percentage of the head and body length. Wakefield and Warneke (1963) compare statistical data from both Tasmanian and mainland Australian *A. swainsonii* and show the average head and body length of the Tasmanian sample as being smaller than the mainland Australian sample. The present material, detailed in table 19, reverses that finding and shows that, in the average, the head and body length of *A. s. swainsonii* slightly exceeds the measurements of *A. s. mimetes* given by Wakefield and Warneke (1963). This is not considered sufficient to be significant and is naturally dependent upon the age of animals in the sample. In other respects the statistical conclusions are nearly similar.

The heaviest male was collected near Waratah on 8.VIII.1964. It weighed 90 gm., was exceptionally robust and carried considerable fat deposits. The lightest male was taken near Cradle Mountain on 21.II.1965. It weighed 27 gm. and was a subadult with a head and body length of 104 mm. The heaviest female was taken near Mt. Barrow on 19.VIII.1965. It weighed 55 gm., had a head and body of 127 mm. and was not carrying pouched young. The lightest female was collected at Renison Bell on 6.II.1965 and was a subadult of 27 gm. with a head and body length of 101 mm.

This size predominance in favour of males also occurs in the larger Tasmanian dasyuridae *Sarcaphilus harrisi* and *Dasyurus viverrinus* (Green 1967a).

	8 Males	14 Females
Weight	48-90 (62.1)	31-55 (43.8)
Total length	219-253 (234.5)	199-228 (210.5)
Tail	90-115 (102.9) 80.3%	83-103 (91.6) 77%
Head and body	122-140 (131.6)	112-127 (118.9)
Ear	17-18 (17.4) 13.2%	15-17 (16.1) 13.5%
Pes	20-22 (21.5) 16.3%	18-21 (19.1) 16.1%

TABLE 19. Weights (gm.) and measurements (mm.) of *A. s. swainsonii*. Quotations show the extremes of adult or near adult animals with the mean in brackets and relative lengths of tail, ear and pes when expressed as a percentage of the head and body length.

Skull

The measurements given in table 20 are from animals collected during this study. Only those with fully erupted adult teeth and of a body weight in excess of 44 gm. for males and 30 gm. for females were selected. This resulted in the inclusion of all and only those of the table 19 series. The fontanelle was ossified in all except two males and four females. Measurements were made, with slide calipers graduated to one tenth of a millimetre, as illustrated by Wakefield and Warneke (1963).

Table 20 shows the skulls of males to exceed those of females in general proportions. This is in conformity with body weight and plastic measurements as is also the case with the larger Tasmanian dasyurids *Sarcophilus harrisi* and *Dasyurus viverrinus* (Green 1967a).

Ossification of the fontanelle is slow and animals may commence to breed before it is complete. A male with a fontanelle opening of 1 x 2 mm., collected on 27 June 1963, weighed 64 gm. and had a head and body length of 129 mm. Testes were developed to 11 x 7 mm. A female with a fontanelle opening of 0.5 x 0.5 collected on 16 October 1964, weighed 45 gm. and had a head and body length of 113 mm. She was carrying eight small pouched young.

Tooth wear is insignificant and does not appear to be of use in determination of the animals age.

The development of the full dental complement is somewhat slow and animals are well advanced before all teeth are fully erupted. The third premolars of both jaws are the last positioned, being immediately preceded by the fourth molars of the upper jaw. Four February collected individuals are detailed in table 21 giving a comparison of the final stages of tooth eruption with the animals body weight and size and degree of fontanelle ossification.

The complete adult dental complement is $I\frac{4}{3}$, $C\frac{1}{1}$, $PM\frac{3}{3}$, $M\frac{4}{4}$. Wakefield and Warneke (1963) give further details of the skull and dentition of *A. swainsonii* and compare it with *A. flavipes*.

HABITS

Disposition and activity

A. swainsonii has an alert and active disposition. It will bite vigorously when first handled and the canine teeth are capable of penetrating the skin of the hand. With a little encouragement it soon tames and is easily handled. Wild caught individuals have been found to take insects from the hand within an hour of capture.

It has an inquisitive nature and when at large explores it's surroundings with zeal: a habit which I believe is often responsible for its being trapped despite normally unattractive bait.

Individuals kept for captive studies were occasionally liberated inside my house for periods up to one hour. They were not alarmed and actively explored secluded retreats, behind the furnishings, apparently searching for prey. Stealth and caution was always evident and, when they abandoned cover, they usually crossed open floor spaces with a quick dash or, as was more often the case, followed the wall footing or edges of furniture. Climbing activities were limited to drapes and places where a firm foothold was easily obtained.

On sawdust and leaf litter it was often observed to "plough" the surface by pushing its nose beneath the material to turn the litter with its head in a "ploughing like" manner.

No observations have been made on the species in the wild state.

Natural retreats

Within its favoured habitat there is usually an abundance of decaying timber and accumulated litter which provides good natural cavities, sometimes forming a labyrinth of surface runways and chambers in which *A. s. swainsonii* gains shelter and seclusion. This habitat is also favoured by the two indigenous rats *P. higginsi* and *R. l. velutinus* and there does not appear to be any difference in the preferences of any of the three species.

In the ecotonal regions *A. s. swainsonii* shelters in hollow logs, natural cavities and beneath dense vegetation such as mature stands of cutting rush *(Ghania trifida)* and button grass *(Mesomelaena sphaerocephala)*. In 1967 a local naturalist brought to the Queen Victoria Museum an old desiccated carcase of *A. s. swainsonii*. It was stated to have been found in a nest of eucalypt leaves, placed in a crevice of a "stringy bark" tree and at a height of about eight feet above the ground. The area was described as virgin forest in the Snowy Range near Huon, southern Tasmania at an altitude of about 600 metres.

Food

An examination of the gut contents of wild specimens has shown that insects form a major part of the diet. Chitineous parts are usually well broken up but soft items are not so well masticated. Earth worms were found in several stomachs and were usually broken into pieces. In one instance a grub, about 30 mm. long, was found to have been swallowed in one piece.

In captivity it has been found to take items ranging in size from mosquitoes to house mice and domestic sparrows. Lizards (see plate 20), moths, spiders, cockroaches and the like were all readily accepted.

BREEDING

Wakefield and Warneke (1963) found breeding in *A. swainsonii* to be restricted to a short period in late winter. Their conclusions are based on a series of 35 females collected, over a period of six years, from Loch Valley, Victoria. The present author has found the Tasmanian subspecies to breed later and over a more extended period.

Ten males trapped in February, two in March and two in April appeared to be all of less than one year old with retracted scrotum and undeveloped testes. Males collected at the end of June, in August and September were found to have pendant scrotum with the testes well developed.

Ten females were trapped in June and one in August. All were found to have the pouch undeveloped.

Two females have been collected with pouched young. These were, 16 October 1964 with eight young of a crown/rump length of 6 mm. and 13 November 1965 with eight young of a crown/rump length of 10 mm.

One female collected on 24 October 1965 was found to have the pouch in breeding condition. The pouch skin was pink with eight nipples of a brighter pink and about one millimetre in length. This animal was kept alive for captive studies but was not noticed to produce young. Embryonic resorption was suspected as a result of shock from the sudden environmental change. This was found to occur in *P. l. velutinus* (Green 1967b).

A female collected on 18 October 1966 likewise was found to have the pouch in apparent breeding condition. The animal was processed into the collections and, in dissection, was found to be carrying 12 embryos, six in each uterine sac (see plate 21). This excess of young over the nipple complement would pro-

vide a higher chance of all the nipples being occupied and allow for some mortality at birth and on the journey from the vaginal opening to the nipple.

A female trapped alive on 11 February was lactating. She was not carrying young and the pouch was partly contracted. The mammary glands were swollen and eight nipples measured about 4.5 mm. (not stretched). She was tagged, released and never recaptured.

A female collected on 23 February had recently ceased lactating. The pouch had retracted to 17 mm. in diameter and was furnished with six nipples, only four of which show evidence of having been suckled. These measured about 3.5 mm. each (not stretched). The remaining two were the anterior pair and were not developed.

This indicates that females may be supporting pouched young from early October to the end of the year and suckling as late as February.

Description of young

The pregnant female collected on 18 October 1966 was found to have two prominent uterine sacs in the shape of laterally compressed spheres measuring 17 x 12 mm. Each carried six embryos of a crown/rump length of 2.3 mm. The embryos were approximately kidney shaped with little character except for slight "budding" where the face, front legs and hind legs were developing.

The pouch of the lactating female collected on 16 October 1964 was furnished with eight nipples of a length of 2 mm. each and some entangled pouch hairs of a pale grey colour and about 6 mm. in length. She had been killed in a snap trap some hours before being collected. The pouch opening measured 18 x 13 mm. and had a slight fold on the anterior edge to provide a pouch depth forward of the opening of about 4 mm. The uterine sacs were contracted to 10 x 5 mm. The eight young were dead and could be removed from the nipples with the slightest tension. They had a crown/rump length of 6 mm. and appeared to be near to newly born. The back and neck were prominently arched and the facial features such as eyes and ears were almost indistinguishable. The lower jaw appeared swollen and relatively large when compared with the rest of the head. The hind legs were club-like buds without division of the toes and were directed forward towards the nose. The tail was pointed, short and only barely exceeded the length of the hind limbs. The front legs, when viewed through a low-power microscope, were found to be equipped with a well formed manus, five splayed toes each with a prominent curved and sharp claw. This advanced development of the manus would assist the newly born young in their initial climb from the vaginal opening to the nipple.

The pouch of the female collected on 13 November 1965 was furnished similarly to the preceding specimen except that the nipples were about 3.5 mm. in length. The pouch opening was 25 x 25 mm. The uterine sacs were completely contracted and the eight young were firmly attached to the nipples, even though dead. The young had a crown/rump length of 10 mm. They were clustered together and suspended mostly outside the pouch proper in the abdomino-inguinal region of the female. The back and neck were well arched with the hind feet and tail held close to the chin. Examination under a low-power microscope showed that the vibrissae had not erupted but a few dark hairs had just erupted in the region of the crown of the head. The rest of the body was completely naked. The ears appeared as slight swellings on the side of the head and the eyes appeared as faintly darkened spots. The hind feet had a formed pes with the toes partly formed. The front feet were well developed but lacked the prominent curved sharp claws observed in the above mentioned (and younger) animals. In these pouched young the claws were very short, stout and blunt suggesting that the pronounced extensions present at birth are shed soon after the young are secure on the nipples. Such prominent and sharp claws would be unnecessary

	MALES				FEMALES			
	No. of specimens	Range	Mean±S. E.	Standard Deviation	No. of specs.	Range	Mean±S. E.	Standard Deviation
Basalar length	7	27.6-31.4	29.34±0.42	1.114	13	25.9-29.0	27.62±0.46	0.753
Zygomatic breadth	8	15.5-17.4	16.29±0.23	0.645	12	14.4-16.4	15.51±0.17	0.579
Postorbital constriction	9	7.6-8.6	7.99±0.11	0.562	13	7.3-8.4	7.73±0.23	0.835
Palatalar length	8	15.8-18.2	16.61±0.31	0.873	13	15.5-16.6	15.76±0.15	0.558
Anterior palatin foramen	8	5.5-6.8	6.05±0.16	0.466	13	5.4-6.4	5.90±0.14	0.522
Alveoli length M^{1-3}	9	5.1-5.7	5.31±0.21	0.639	13	5.0-5.6	5.22±0.05	0.171
Breadth at M^3	9	8.5-9.2	8.83±0.08	0.221	13	8.3-9.1	8.63±0.06	0.230

TABLE 20. CRANIAL MEASUREMENTS OF MALES AND FEMALES OF *A. s. swainsonii* (in millimetres).

Date	Sex	Wt. (gm.)	Head & Body (mm.)	Fontanel Opening	Deciduous teeth present	Adult teeth not erupted	Adult teeth partly erupted
5.II.1965	F	29	108	1.5x2	PM^{0-3}	-	PM^{3-3}_{3-3} M^{4-4}
8.II.1965	M	35	105	1.8x2.4	PM^{3-3}_{3-3}	PM^{3-3}_{3-3}	M^{4-4}
11.II.1965	M	-	103	1.0x1.5	-	-	PM^{3-3}_{3-3} M^{4-4}
21.II.1965	M	27	104	0.5x1	PM^{0-3}_{3-3}	-	PM^{3-3}_{3-3} M^{4-4}

TABLE 21. COMPARISON OF BODY SIZE, WEIGHT AND FONTANELLE OPENING WITH THE FINAL STAGES OF TOOTH ERUPTION IN FOUR *A. s. swainsonii*.

during suckling and would probably be capable of inflicting injury as the young develop and gain in strength.

MISCELLANEOUS OBSERVATIONS

Trapping

No attempt was made specifically to trap *A. s. swainsonii*. All animals collected were taken in traps set for small mammals in general and indigenous rats in particular (see parts 1 - 4). The common household rat trap was the principal means of collecting. Sherman box traps, made of galvanised sheet steel and measuring about 22 x 8 x 8 cm., were used when live animals were wanted.

Various baits were used including rolled oats, peanut butter, honey, raisins and chopped bacon mixed in various proportions. Apple, cheese, bacon, raisins, raw meat, plain bread and bread scented with vanilla were also used separately. No preference was noticed and the majority of catches appeared to result from the animals' inquisitive nature or as a consequence of walking over the trap. The trap sites chosen were usually semi-secluded such as inside a hollow log, beneath fallen timber, beneath dense vegetation, outside holes and beside large logs where animals would have a tendency to run. Trapping success was variable but in good habitat one in 25 trap nights was a reasonable expectation. Very little skull damage occurred as a result of the use of snap traps.

Some details of the smallest and apparently youngest animals trapped are given in table 21.

Field studies

Field studies were conducted in the Cradle Mountain area and were incidental to the study of indigenous rats (see parts 1 - 4). In 560 trap nights 16 *A. s. swainsonii* were trapped alive, ear tagged with numbered fingerling fish tags, weighed, measured, examined and released. They comprised seven females, eight males and one animal the sex of which was not recorded.

Tagging was undertaken in two adjacent areas selected principally for their populations of the indigenous rats *P. higginsi* and *M. fuscus*. The latter species was found inhabiting an area of poa tussock into which *A. s. swainsonii* had penetrated from the adjacent heavy beech rainforest. Traps were set to form two parallel lines about 40 metres apart and at intervals of about 20 metres between traps. One site was on the edge of beech (Nothofagus) dominant rainforest and the other, though only about 100 metres distant, was treeless and vegetated principally with poa tussock (see parts 3 and 4).

The first 240 trap nights, during October and December 1965, failed to produce any *A. s. swainsonii* though a number of rats were captured. Subsequent trapping on 320 trap nights in February, June, July and October 1966 produced 16 *A. s. swainsonii* on 12 occasions. Two males and two females were retrapped on the day of capture and in the vicinity of their original place of capture. Only one *A. s. swainsonii* was retrapped after a significant time lapse. This was a male originally trapped on 12 February 1966 and retrapped on 3 June 1966 about 300 metres distant from the original place of capture. It had gained in body weight from 32 gm. to 65 gm.

Keeping in captivity

Several adult *A. s. swainsonii* were kept in cages 18 inches by 10 inches by 12 inches high. Diet consisted of raw mutton, dead birds, mice and insects. Though they ate regularly and appeared healthy, none survived more than three months.

All such captives could be easily handled and exhibited little fear or ferocity. When handled, activity appeared to be stimulated more by their inquisitive nature rather than any desire to escape and biting of the hand rarely occurred. The nose was often used to pry into spaces in a semi-closed hand or between the fingers and they showed considerable ability to force their way through tight places. When released inside the house their active curiosity would be continued as outlined under "Habits."

Parasites

Ectoparasites have been collected whenever opportunity permitted and have been lodged with the National Insect Collection in Canberra. Table 22 gives details of these samples.

TABLE 22. ECTOPARASITES COLLECTED FROM *A. s. swainsonii*

	ACARINA
Ticks (determined by Dr. F. H. S. Roberts)	
Ixodes tasmani	Cradle Mountain (larvae) 20.III.1963; (♀) 22.VI.1964; Renison Bell (nymph and larvae) 23.II.1964
I. antechini	Waratah (♀ nymph and larvae) 27.VI.1963; Renison Bell (larva) 23.II.1964; (♀) 6.II.1965; Cradle Mountain (♀♀) 22.VI.1964; (♀) 12.II.1966
	INSECTA
Fleas (determined by Dr. G. M. Dunnet)	
Acanthopsylla sp. nov.	Cradle Mountain 20.III.1963; 26.IV.1963
Pygiopsylla hoplia	Cradle Mountain 20.III.1963
Stephanocircus sp.	Cradle Mountain 26.IV.1963
Macropsylla hercules	Waratah 27.VI.1963
Mites (determined by Mr. R. Domrow)	
Gymnolaelaps annectans	Cradle Mountain 20.III.1963
Lice	
Undetermined nymphs only,	Cradle Mountain 18.X.1966

The brains of two *A. s. swainsonii* were sent to the Department of Agriculture for inclusion in a survey of Toxoplasmosis in Tasmania and one produced positive results (Munday 1966). The lungs of two were examined by the same authority for *Emmonsia crescens*: both produced negative results.

Natural enemies

A. s. swainsonii appears to be relatively free from natural predators. The larger dasyurids, masked owl *Tyto castanops* and larger snakes doubtless take some toll in ecotonal habitat where populations overlap but its preference for dense rainforest keeps it mostly beyond the reach of these predators. Feral cats rarely occur in this habitat.

The apparent inability of *A. s. swainsonii* to establish and maintain itself in dry sclerophyll forest may be a result of predation. Many such areas appear

ideally suited to its requirements. These are often the stronghold for the larger dasyurids, owls, hawks and feral cats. In this habitat the niche may be occupied by the very much larger and often prevalent short-nosed bandicoot *Isoodon obesulus*. This animal's diet overlaps that of *A. s. swainsonii* in many respects and, though it favours bushland and forest areas, it generally shuns the rainforest habitat in which *A. s. swainsonii* occurs.

Much of Tasmania's rainforests are in the western region and extensive areas are included in national parks. Because of high rainfall and naturally damp conditions they are relatively safe from uncontrolled fires.

I see no reason why *A. s. swainsonii* should not continue as a common mammal within the confines of its present distributional limits.

PART 6. *Antechinus minimus* (Geoffroy, 1803)

ABSTRACT

The Tasmanian subspecies of little phascogale *Antechinus minimus minimus* was collected as part of a small mammal study from 1963 to 1966. Its distribution was found to be confined mostly to the western half of Tasmania, Maatsuyker Island, Flinders Island and King Island. Its preferred habitat is the wet sedgeland and drainage areas, provided sufficient vegetational cover exists, where it utilises the well defined runways formed by the indigenous velvet-furred rat *Rattus lutreolus velutinus* and broad-toothed rat *Mastacomys fuscus*.

Males exceed females in body proportions by a significant amount. The heaviest male collected weighed 57 gm. and the heaviest female 52 gm. This is considerably less than the average for *A. s. swainsonii* (given in part 5). Insects, larvae and earthworms are included in the diet.

A female, carrying six pouched young of a head and body length of 40 mm., was collected on 6.XII.1964. The nipple complement has been found invariably to be six.

Trapping in selected habitats during autumn and winter produced a catch of about one *A. m. minimus* to 40 trap nights with no obvious bait preference. Most catches were made on runways formed by indigenous rats.

Some ectoparasites have been collected and determined.

The already restricted habitat of *A. m. minimus* is being progressively invaded by man's penetration of the western region for its industrial, mineral and grazing potential. The species seems destined to be drastically reduced by further habitat destruction.

DISTRIBUTION

A. minimus was a relatively little known mammal for many years. Recent studies have shown it to be widely distributed but found principally in the western half of the island. Wakefield and Warneke (1963) suggest that the typical habitat of the species is coastal but the experience of the present author indicates that this is not necessarily so in Tasmania. Here its distribution is associated with the wet sedgeland and swampy drainage areas which range from subalpine to the coast (see map, figure 12) and it has been collected at altitudes ranging up to 1000 metres. Its probable present distribution is shown in figure 12. This is based on the localities from which specimens have been collected and the range of its preferred habitat. Within these limits there are extensive areas of rainforest which are broken up by the wet sedgelands occurring as forest openings (Jackson 1965). *A. m. minimus* rarely occurs

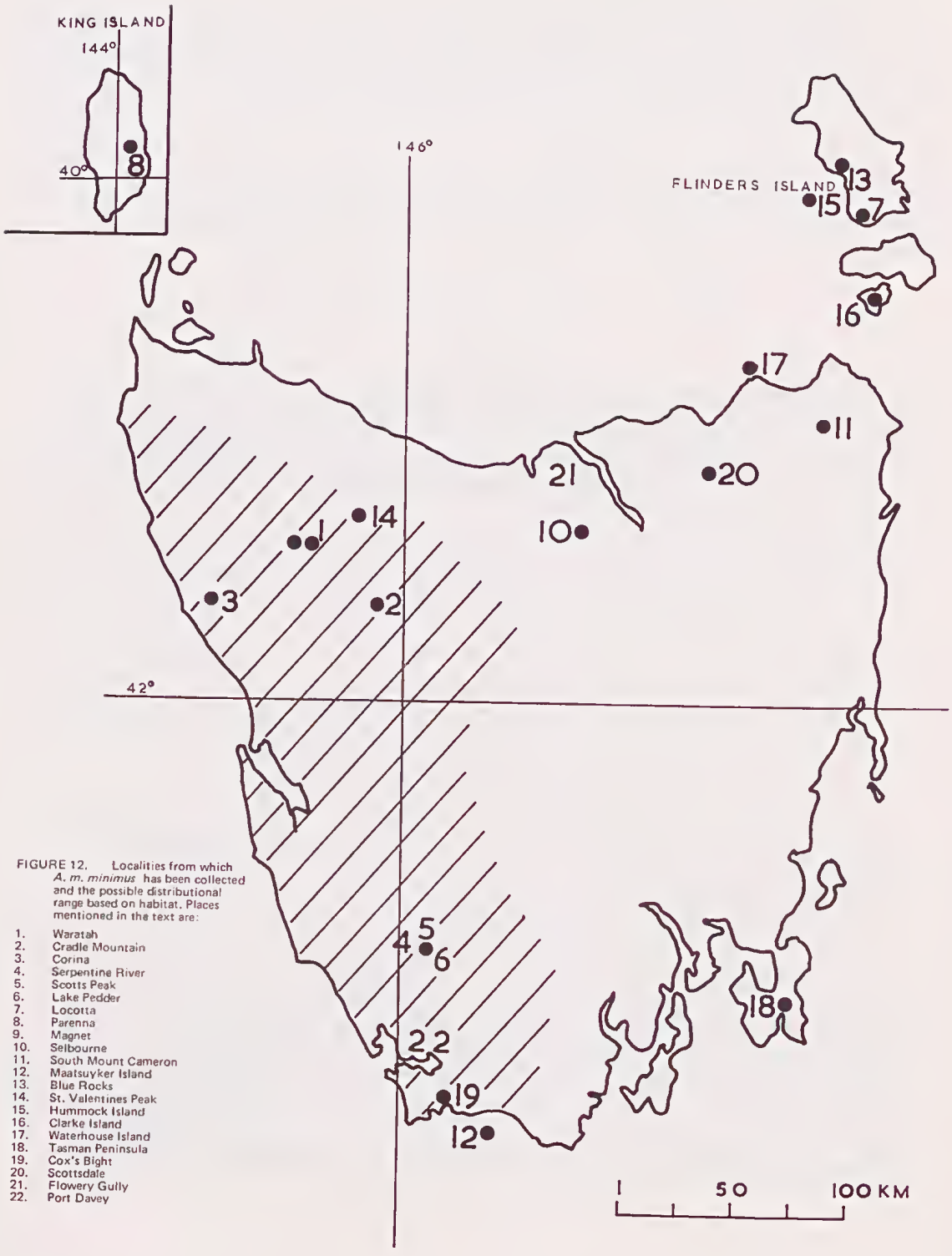

FIGURE 12. Localities from which *A. m. minimus* has been collected and the possible distributional range based on habitat. Places mentioned in the text are:

1. Waratah
2. Cradle Mountain
3. Corina
4. Serpentine River
5. Scotts Peak
6. Lake Pedder
7. Locotta
8. Parenna
9. Magnet
10. Selbourne
11. South Mount Cameron
12. Maatsuyker Island
13. Blue Rocks
14. St. Valentines Peak
15. Hummock Island
16. Clarke Island
17. Waterhouse Island
18. Tasman Peninsula
19. Cox's Bight
20. Scottsdale
21. Flowery Gully
22. Port Davey

in the rainforest but it is usually present in the associated treeless, sedgeland openings and ecotonal areas, provided the vegetational cover is sufficiently dense.

Trapping conducted in the course of this study produced specimens from near Waratah, Cradle Mountain, Corinna, the Serpentine River Valley and Scotts Peak near Lake Pedder, Locotta on Flinders Island and Parenna on King Island. The Queen Victoria Museum also holds two males (reg. nos. 2054 and 2055) collected at Magnet (near Waratah) on 3.II.1904 and 9.II.1904 respectively. Once a mining settlement, Magnet is now abandoned and access is difficult. The two specimens were taken when they entered an occupied house. Also included are a male (reg. no. 1944/73) which was caught alive on the bank of a creek near Selbourne on 8.VIII.1944, a male (reg. no. 1944/57) found dead in the bush near South Mount Cameron on 24.VII.1944, a male (reg. no. 1946/1/11) from Maatsuyker Island and a male (reg. no. 1961/1/12) from Blue Rocks, Flinders Island in June 1961. The Tasmanian Museum holds specimens collected one mile west of St. Valentines Peak on 13.VII.1962 and four males collected near Lake Pedder in February 1967 (Andrews 1968).

Wakefield and Warneke (1963) trace the history of its discovery and taxonomy and cite additional records from King Island, Hummock Island (= Chappell Island), Clarke Island, Waterhouse Island, Tasman Peninsula, Cox's Bight, the far north-east coast and Scottsdale. The draining of swamps and land development has no doubt resulted in the local annihilation of some of these populations. Among the subfossil bone material from the Flowery Gully limestone caves are several maxilla and mandible remains which were determined by Mr. J. A. Mahoney as this species (Gill 1968).

HABITAT

The wet sedgelands (see part 3, plate 1) and associated drainage areas have been found to be a favoured habitat of *A. m. minimus* and with few exceptions, all specimens collected have been taken in or near to areas of *Mesomelaena sphaerocephala* (button grass).

This may be interspersed with *Calorphus lateriflorus* (spreading rope-rush), *Restio australis* (mountain cord-rush), and *Lepidosperma filiforme* (common rapier-sedge). The extent and distribution of this plant community is considerably affected by fire and Jackson (1965) discusses this and other influencing factors. *A. m. minimus* also occurs in the ecotone on the verges of the rainforest where the plant community is more complex and may include *Ghania trifida* (cutting rush), *Sprengelia incarnata* (swamp heath), *Epacris gunnii* (Gunn's heath), *Leptospermum* sp. (tea tree), *Monotoca* sp. (broom heath), *Boronia rhomboidea* (diamond heath), *Gleichenia alpina* (dwarf coral-fern), stunted *Casuarina dystyla* (oak), stunted *Eucalyptus gunnii* (cider gum) and occasionally patches of *Poa caespitosa* (tussock grass). Spagnum moss occurs widely and in some places forms moss bogs several feet deep. This habitat likewise is favoured. Collecting has shown *A. m. minimus* usually is present in the same areas as the indigenous broad-toothed rat (*Mastacomys fuscus*) and usually is taken when trapping for that species but it appears less selective in its habitat preference and will penetrate the ecotone and drier elevated banks more than *M. fuscus*. On only one instance has *A. m. minimus* been taken in rainforests. This was a subadult female trapped near Corinna on 8.II.1964 and was probably a footloose vagrant.

The isolated occurrences from areas not included within the principal distribution range (see map, figure 12) indicate old records or the presence of isolated relict populations. These are probably the remains of an earlier wider distribution which has been reduced progressively by gradually changing climatic and environmental conditions. They occur in the vicinity of relict-like habitat which is similar to that previously described. Near Selbourne there are expanses

of river flats which once were wet marsh lands but, in recent years, have been drained, ploughed and sown to improved pastures. It is reasonable to assume that this was the habitat of the specimen (reg. no.1944/73) and that the extensive habitat alterations have since annihilated the local population.

Climatic conditions are variable with rainfall ranging from over 250 cm. in western areas to about half this figure in the eastern habitats. Temperature may fall to -12°C in the western subalpine region during the winter and reach about 35°C on the coast during summer. Much of the subalpine habitat is subject to heavy winter snowfall which may lie at a depth of 30 cm. and considerably more in the exposed drifts, for several weeks at a time (see part 2, plate 2). This results in the isolation of areas and restricts the individual range by confining the animals beneath the snow. Trapping and examination of the habitat under these conditions indicates that *A. m. minimus* does not leave the shelter beneath the snow covered vegetation but continues to live an apparently normal existence in the micro-habitat until released by the thaw.

In February 1967 the Queen Victoria Museum and the Tasmanian Museum combined to undertake a zoological survey in the vicinity of Lake Pedder. The location in which the work was carried out (see part 4, plates 14 and 15) is at an altitude of about 290 metres and the habitat is consistent with much of the western highlands. Much of it will be flooded with the completion of dams for water storage for the generation of electricity. Trapping undertaken by J. W. Swift resulted in the capture of four *A. m. minimus* in an area of tea-tree and button grass swamp in the Serpentine River valley, an aerial view of which is illustrated by Davies (1965), near Scotts Peak and near the shore of Lake Pedder (see part 4, plates 14 and 15). Much of the habitat in which these animals were taken is swampy or waterlogged for much of the year and only in the mid-summer does it dry out to any extent. *M. fuscus* and *R. l. velutinus* were also collected in the same habitat as is usual in other proven *A. m. minimus* localities. As a result of his experience in this area Swift (pers. comm.) is of the opinion that *A. m. minimus* is relatively plentiful through the valley systems.

Andrews (1968) gives further details of the area and lists other local mammal fauna.

DESCRIPTION

Wakefield and Warneke (1963) give a description of *A. minimus* with tables showing body and skull proportions and comparisons between Tasmanian and Australian mainland populations. They discuss earlier descriptions and the type specimen collected from Waterhouse Island (off north-eastern Tasmania) by Péron and Lesueur on 17 March 1802 and demonstrate that the nominate Tasmanian population is subspecifically distinct from the Australian mainland population *A. m. maritimus*. Much of the Tasmanian mainland material available to Wakefield and Warneke (1963) for their revision came from the Queen Victoria Museum collection. This series has since been expanded and the present description is based on nine spirit preserved animals and 24 skins with skulls.

External characters

The general form of *A. m. minimus* closely resembles that of *A. s. swainsonii*. It is stout with relatively large hindquarters, has a broad strong neck and a narrow pointed snout which, while not so pronounced as in *A. s. swainsonii*, tapers evenly to small, naked, dark grey nostrils. The ears are short, rounded and when pressed forwards reach the middle of the eyes. They are covered both posteriorly and anteriorly with very short bristle-like hairs, those of the anterior region being brown, sandy or banded in both colours, while those of the posterior surface are more uniformly brown. The anterior surface of the lobe usually carries a tuft of hair considerably longer than on the rest of the ear.

The eyes are small with the iris dark-brown and the pupil black. They are set in the sides of the head and slightly behind to the mid-point between the nostrils and the ear.

The legs are short and the feet broad. The upper surfaces including the toes are covered with short bristle-like brown hairs which just overlap the base of the nails on the toes of the front feet but may extend to the tips of the nails on the tops of the hind feet. The toes are stout with the claws long, sharp, slightly curved and generally lacking pigmentation. The first digit of the hind foot is relatively short, lacks a toe nail and terminates in a naked pad overlaid with a few short hairs. The undersurface of the feet is slightly variable in colour, ranging from pale grey to a dirty white. The manus is usually paler than the pes. These are described by Wakefield and Warneke (1963) who found both the manus and pes of *A. swainsonii* and *A. minimus* to be indistinguishable. The digital formula of the front and hind feet is 3>4>2>5>1.

The tail is shorter than the head and body (see table 23) slender and tapers gently to a fine tip. The tail scales are not well defined and in colour, distribution and bristle arrangement approximate those of *A. s. swainsonii* (see part 5).

The bristles on the extremity of the tail may reach 4 mm. but on the rest of the tail the longest rarely exceeds 2 mm. On the dorsal surface they are very dark brown but on the under side they fade to very pale brown. Body pelage extends on to the basal region for about 10 mm. The nipple complement has been found to be always six which is in conformity with that found in *A. m. minimus* by Wakefield and Warneke (1963). They record eight as the standard complement in the mainland Australia *A. m. maritimus*. Nipples are arranged three on each side of the pouch but in subadult animals they are difficult to locate because of lack of pouch development.

When pouch development takes place the opening is from the rear but it lacks depth and is formed primarily by lateral skin folds.

The scrotum is pendulous and well formed in tones similar to the adjacent ventral pelage.

Pelage

Sexual dimmorphism is not apparent in the pelage. The fur is soft, dense and relatively short, particularly in subadults, and will not part readily even is brushed backwards.

The main pile is longest on the back and rump where it reaches to 12 mm. in well furred individuals but on the ventrum, it rarely exceeds 8 mm. On the crown of the head it is reduced to 5 mm. Guard hairs exceed the main pile by about 5 mm. on the back and rump, 3 mm. on the ventrum and 1 mm. on the crown. They taper to a fine point and on the dorsum and flanks are a lustrous black, coarse and straight in their terminal half but finer and less robust in the basal half. Those of the ventrum are less bold and of a pale sandy brown colour.

The main body pile is leaden grey for most of its length. On the dorsum and flanks there is a subterminal band of tan which, in adults with mature pelage, is pale towards the head but on the rump is darker and has a rich lustre. The extreme tip of most fibres is a lustrous black.

On the ventrum the black tip is absent and the main pile terminates in a very pale sandy tan. This is often much darker in the region of the base of the tail. In subadults with immature pelage the tan is usually lacking or absent. The composite effect in mature adults is a dark brownish grey dorsally, being distinctly inclined to a rich tan hue on the rump, posterior flanks and round the round the base of the tail. The ventrum appears as a very pale sandy grey

Plate 20. *Antechinus swainsonii swainsonii*, a captive animal feeding on a metallic skink lizard.

Plate 21. *Antechinus swainsonii swainsonii*, trapped on 18 October 1966 in a pregnant condition. Dissection revealed 12 embryos.

Plate 22. *Antechinus minimus minimus*, female with six pouched young, trapped on 6 December 1964.

Plate 23. *Sminthopsis leucopus*, adult male and subadult female which were found in a nest of shredded bark in a stack of firewood near Holwell on 16 April 1965. Photo by Mr. H. J. King.

becoming shaded with tan near the base of the tail. In subadults with immature pelage the effect is usually a more uniform dark brownish grey except for the paler ventrum.

This distinct tan effect in the region of the rump of most adult *A. M. minimus* is a character which points to this species and helps tentatively to separate it from the nearly similar *A. s. swainsonii*.

Lyne and McMahon (1951) give details of the surface structure of the hair.

The mysticial vibrissae are in five rows and reach to 20 mm. but in adults they are often reduced due to breaking of the tips. They are noticeably less conspicuous than those of *A. s. swainsonii* which on the average are considerably longer. The vibrissae are black and gently tapered over their entire length and if unbroken terminate in an extremely fine tip. Because of breakage the longer posterior members are often reduced, the number showing usually ranging from four to ten. The shorter and finer anterior members are more numerous and are not noticeably reduced by breaking. A few genal and supra orbital vibrissae are also present and one or two ulna carpals show on some animals.

An albino *A. m. minimus* was collected from the south west of the state in February 1967 and lodged with the Tasmanian Museum (Andrews 1967).

Plastic dimensions

Plastic measurements were taken as described in part 5. The details given in table 23 are based on adults or near adult animals with fully erupted adult teeth. This has necessitated the exclusion of four males and one female collected in the month of February. Animals collected on offshore islands have also been excluded.

Males attain a greater body weight and size than do females. (see table 23). This is in conformity with other dasyurids (Horner and Taylor 1959, Wakefield and Warneke 1963, Green 1967*a*). There is no significant difference between the sexes in the length of the tail ear and pes relative to the head and body length. Expressed as relative percentages, these measurements are less than those given for *A. s. swainsonii* in part 5, particularly for the tail.

Measurements given by Wakefield and Warneke (1963) for *A. m. maritimus*, in the average exceed those of *A. m. minimus* but the small samples available render the results inconclusive. They give the greatest head and body length in their series of males of *A. m. maritimus* as 140 mm. This is 8 mm. less than the largest animal (weight 55 gm.) collected in the present study (see table 23).

The smallest male collected from the Tasmanian mainland was a subadult with the third upper premolars and the fourth upper and lower molars not fully erupted. It was one of three nearly similar subadult males trapped near Lake Pedder in February 1967 and had a body weight of 34 gm. and a head and body length of 93 mm. The pelage was considerably shorter than that of adults and lacked the tan shading, being almost a uniform mouse grey.

The smallest female was a subadult with upper and lower third premolars and fourth molars only partly erupted. It was trapped near Waratah in June 1963, had a body weight of 30 gm. and a head and body length of 98 mm. Its pelage was shorter and more greyish than the adults but the difference was not as pronounced as it was in the smallest male.

The smallest male collected was a subadult trapped near Locotta on Flinders

Island on 25.II.1967. It had a body weight of 19.5 gm. and a head and body length of 88 mm.

	10 Males	12 Females
Weight	30-57 (44.8)	24-52 (32.25)
Total length	174-230 (195.9)	165-203 (178.83)
Head and body	103-148 (118.6)	99-115 (104.83)
Tail	65-84 (77.3) 65.2%	65-88 (74.0) 70.6%
Ear	13-15 (14.35) 12.1%	13-15 (14.18) 13.5%
Pes	17-20 (18.45) 15.6%	17-18.5 (17.33) 16.5%

TABLE 23. Weights (gm.) and measurements (mm.) of *A. m. minimus*. Quotations show the extremes of adults or near adults with the mean in brackets and relative lengths of tail, ear and pes expressed as a percentage of the head and body length.

Skull

Measurements given in table 24 were made as described in part 5 and are from animals collected from the Tasmanian mainland. Individuals from offshore islands and those in which all the adult teeth had not fully erupted have been excluded.

On the average males were found to exceed females in all the proportions measured. This is in conformity with the plastic measurements as is also the case with other dasyurids.

The fontanelle ossifies at an earlier age than in *A. s. swainsonii* as no *A. m. minimus* were collected in which it was not completely closed. This is considerably more advanced than was found with *A. s. swainsonii* (see part 5).

Tooth wear is not obvious and does not assist in determining age. Development of the full adult dental complement is slow and animals are well advanced before it is complete. The third premolars and fourth molars are the last to erupt.

The complete adult complement is $I\frac{4}{3}$, $C\frac{1}{1}$, $PM\frac{3}{3}$, $M\frac{4}{4}$. Wakefield and Warneke (1963) give additional details of the skull and photographs of the type held in the Paris Museum.

HABITS

Disposition and activity

A. m. minimus is alert and active in very much the same manner as *A. s. swainsonii* (described in part 5). One female was kept in captivity for ten days but always maintained a nervous, spiteful disposition and would bite vigorously whenever handled. When released its activity was always directed towards escape

	MALES				FEMALES			
	No. of Specimens	Range	Mean ± S.E.	Standard Deviation	No. of Specimens	Range	Mean ± S.E.	Standard Deviation
Basalar length	8	25.0-29.5	26.61±.54	1.536	10	23.7-26.3	24.89±.40	1.266
Zygomatic breadth	7	14.7-17.9	15.99±.44	1.176	10	14.2-15.6	14.92±.16	.494
Postorbital constriction	10	7.3- 8.5	7.69±.11	0.345	11	7.2- 7.8	7.44±.07	.224
Palatalar length	10	14.1-16.5	14.88±.12	0.669	11	13.2-15.0	14.0 ±.16	.529
Anterior palatin foramen	10	3.1- 4.0	3.39±.08	0.246	11	2.8- 3.6	3.09±.09	.284
Alveoli length M^{1-3}	10	4.7- 5.0	4.86±.24	0.759	11	4.6- 5.0	4.78±.14	.467
Breadth at M^3	10	8.3- 9.4	8.79±.10	0.311	11	8.1- 8.8	8.51±.06	.250

TABLE 24. CRANIAL MEASUREMENTS OF MALES AND FEMALES OF *A. m. minimus* (in millimetres).

and it lacked the docile inquisitive nature of *A. s. swainsonii* kept under similar conditions.

Natural Retreats

The preferred habitat of *A. m. minimus* is generally treeless and wet. Consequently the only available nesting sites are in the dense surface vegetation sufficiently elevated to clear any free water. No nests which could be positively attributed to this species have been found.

It makes use of runways formed and used by native rats beneath the vegetation but it probably plays little or no part in their formation and maintenance. Trapping has shown it usually lives in close proximity to the indigenous rats *M. fuscus* and *R. l. velutinus*, both of which form and maintain extensive runway systems (see parts 2 and 4).

Food

An examination of the gut contents of wild specimens has shown most to contain finely masticated insect remains. In one case insect remains and very small grubs were present while in another the contents were solely very small grubs. One gut was found to contain an earthworm.

Mr. Denison King informs me that he has watched *Antechinus* sp. attempting to catch small birds. In his garden at Port Davey he had attracted wrens and other birds to a feeding area with bread crumbs. This food also attracted *R. l. velutinus*. The birds paid little heed to the rats but, upon the approach of a phascogale, the alarm call was always given. On several occasions he saw a phascogale make a sudden dart towards small birds on the ground but did not see any succeed in catching one. On the basis of adjacent habitat it is probable that the phascogale in question was of this species.

BREEDING

Only one *A. m. minimus* has been collected with young in the pouch (see plate 22). This was on 6.XII.1964 from an area near Cradle Mountain. The female's body weight (excluding young) was 52 gm. with a head and body length of 115 mm. The pouch was distended to occupy almost all of the abdomino-inguinal region and lacked any anterior or posterior depth. The lateral flaps were produced as if to fold round the young on each side. The six nipples were situated in the posterior half and arranged in the form of a U with the distance between the anterior pair being about twice that of the posterior pair. The pouch was furnished with a few reddish brown hairs to 5 mm. in length and the mammary glands and nipples were enlarged.

Only one other female has been collected which showed indication of breeding. This was a live trapped animal caught on 18.X.1964 in which the pouch was enlarged to an area of 15 x 15 mm. The six nipples were 2 mm. in length and appeared to have been lightly suckled. Because of the possibility that she may have been about to produce young it was decided to keep her in captivity. On 27.X.1964 she was found dead with the pouch and nipples considerably contracted. No indication could be gained as to the possible fate of her young, but upon reflection it appeared she may have eaten them while in the trap as a result of stress during her initial period of captivity.

Seven females trapped during the month of June all lacked any signs of pouch development.

Subadult males collected in February had scrotums of about 8 x 6 mm. but by June the scrotums of males had enlarged to 18 x 16 mm. with testes to 10 x 8 mm.

It is probable that the breeding season of *A. m. minimus* parallels that of *A. s. swainsonii*, that is from September to the end of the year (see part 5). This is somewhat later than that indicated for *A. m. maritimus* on mainland Australia by Wakefield and Warneke (1963).

Description of young

The six pouched young (3 males and 3 females) of the female mentioned above are believed to be the only ones of this species collected to date and are spirit preserved with the female, reg. no. 1964/1/316. They had a mean weight of 3 gm., a head and body length of 40 mm. and a tail of 15 mm. The head, from the base of the skull to the tip of the nose was 18 mm. and appeared large in comparison to the body. No teeth had erupted but the lower incisors were well advanced and produced a swelling in the gum. The eyes were closed and the ears sealed and non-functional with the pinnae directed posteriorly. The claws of the manus were stout, strongly curved and of an off-white colour, often with dark tips. Those of the pes were slightly less pronounced and of an off-white colour with dark tips.

The pouch of the females appeared as two lateral inguinal folds each of about 3 mm. long and 2 mm. apart. The scrotum of the males was approximately spherical, pendant and about 1.5 mm. in diameter.

The entire ventral surface was clothed in fine white hairs to 0.3 mm. in length while on the dorsal surface the pelage was grey and reached 5 mm. Vibrissae were well developed, the mysticial being in five rows numbering up to 5, 8, 9, 11, 9 per row and reaching to 5 mm. Also present were up to 5 genal to 3.5 mm., 2 supraorbital to 3.5 mm., 4 interramal to 2 mm., 8 submental to 1 mm., 6 ulnarcarpal to 2 mm., and 1 medium antebranchial to 2 mm.

MISCELLANEOUS OBSERVATIONS

Trapping

No attempt was made specifically to trap *A. m. minimus* and all animals collected were taken while trapping for small mammals in general as described in part 5. No bait preference was noted and many animals were caught as a result of their having fired the traps by walking over the trigger mechanism. Trap sites where *A. m. minimus* were usually caught were on surface runways formed beneath dense vegetation. Trapping success was variable and populations were often difficult to detect from the general appearance of the habitat. The autumn and winter months appear most productive and, at this time of the year in suitable habitat, a catch of one in 40 trap nights might be expected. Skull damage as a result of the use of snap traps occurred rarely. Adult males were caught during the months of February, March, April and June but no mature males were taken in other than June. Adult females were caught in February, June, October and December.

Parasites

Ectoparasites collected during the study have been lodged with the National Insect Collection in Canberra and the following determinations have been provided.

ACARINA

Mites (determined by Dr. F. H. S. Roberts)

Pneumonyssus dentatus Waratah June 1963.

Gymnolaelaps annectans Waratah June 1963.

INSECTA

Fleas (determined by Dr. G. M. Dunnet)

Stephanocireus sp. nov. Waratah June 1963.

Pygiopsylla hoplia Waratah June 1963.

The brains of two *A. m. minimus* were sent to the Department of Agriculture for inclusion in a survey of Toxoplasmosis in Tasmania and one produced positive results (Munday 1966). The lungs of one were examined by the same authority for *Emmonsia crescens* with negative results. What is believed to be the first report of pulmonary mites in *A. minimus* is made by Munday (1966) as a result of this examination.

Natural enemies

No evidence has been found to suggest heavy predator pressure on *A. m. minimus*. No doubt some are taken by snakes, masked owls (*Tyto castanops*), and quolls (*Dasyurus viverrinus*). The latter species is prevalant in some areas near to *A. m. minimus* populations and has been found to take indigenous rats.

Feral cats do not occur in sufficient numbers to be of significance as a predator species. It appears that the greatest factor limiting its population is the availability of suitable habitat which closely parallels that of the indigenous rat *M. fuscus*. Both species once enjoyed a wider range of distribution than today (see also part 4) but climatic change and habitat alteration, both natural and man made, have resulted in this being restricted mostly to the western region and, in the case of *A. m. minimus*, on some of the offshore islands.

Much of its habitat is subjected to summer fires which, because of the remoteness and lack of any commercially valuable vegetation, often burn uncontrolled for long periods. Though fire was a factor in the maintenance of these treeless areas in the pre European era (Jackson 1965) it does, at the same time, render the effected areas uninhabitable for several years. It also appears that the stage of regrowth at which rehabitation occurs is approximately equal to the stage at which it will support free burning.

In some of these areas cattle are grazed during the summer months and, because of their being attracted to the drainage areas for water and feed, they can by their concentrated trampling, "camping" and grazing render the area uninhabitable.

Another factor which will in future further reduce the habitat is the flooding of some valleys by the damming of rivers for hydro-electricity production. The habitat so often follows the low lying areas, which are the first to be inundated as the reservoirs fill.

It is also possible that mineral development will, in the future, have some detrimental effects as it brings with it the inevitable environmental changes.

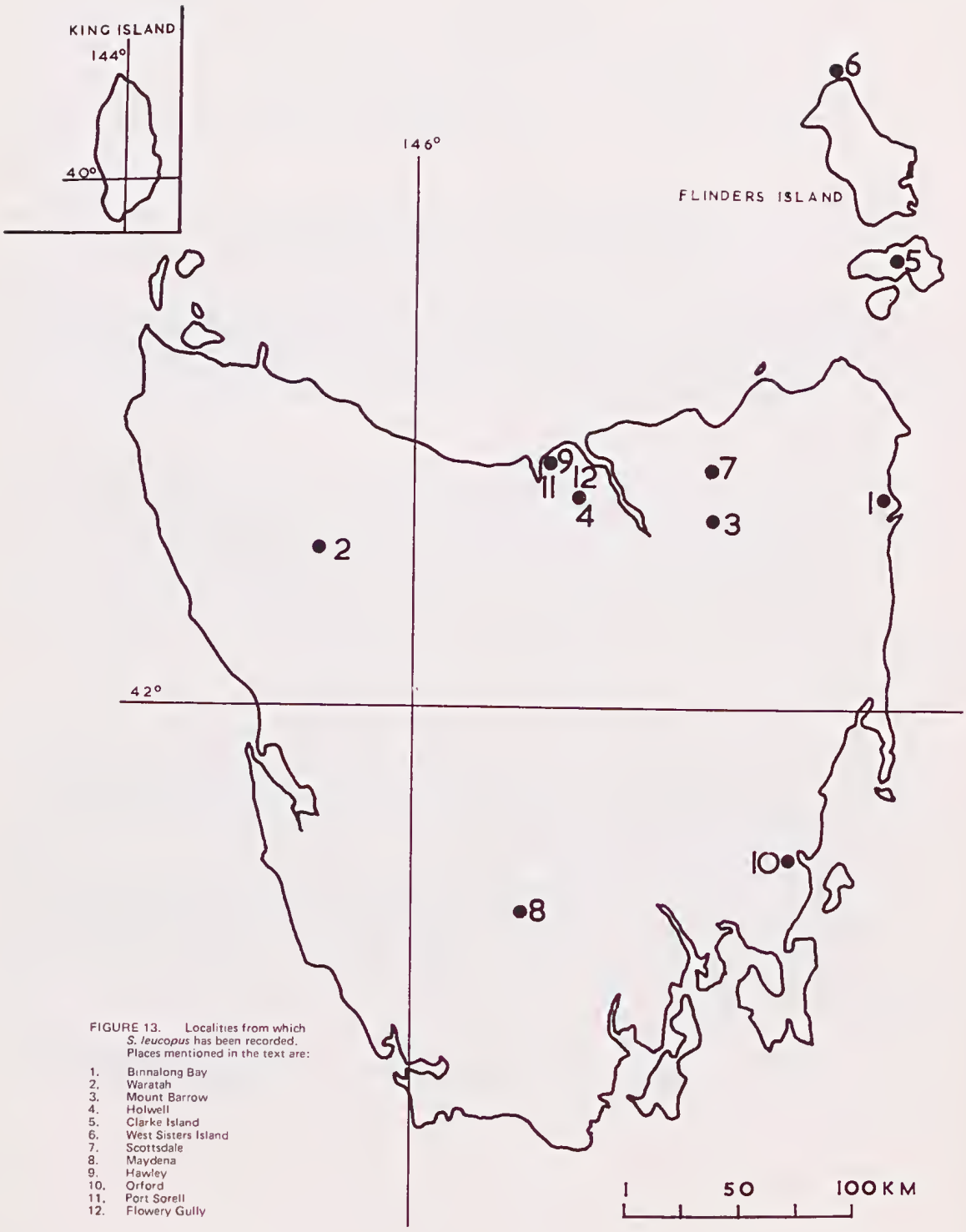

FIGURE 13. Localities from which *S. leucopus* has been recorded. Places mentioned in the text are:

1. Binnalong Bay
2. Waratah
3. Mount Barrow
4. Holwell
5. Clarke Island
6. West Sisters Island
7. Scottsdale
8. Maydena
9. Hawley
10. Orford
11. Port Sorell
12. Flowery Gully

The occurrence of *A. m. minimus* on King Island and Flinders Island to the apparent exclusion of *A. s. swainsonii* is interesting and leads to some speculation as to the local environment prevailing at the time of the recent isolation following the last land bridge. At present there is on Flinders Island (Green 1969) and on King Islands (paps. prep.) a distinct bias towards a wet sclerophyll rainforest avifauna amongst the species which are traditionally sedentary though most of the habitat is now of a dry sclerophyll nature. In addition a number of sedentary dry sclerophyll species which may be expected to occur are in fact absent.

It appears probable that at the time of recent isolation, a habitat existed which somewhat resembled that occurring in western Tasmania today. This is a mosaic of rainforest with wet sedgelands openings in which *A. swainsonii* and *A. minimus* occur in close proximity. The changes in climate and resultant changes in vegetation which have since taken place could be responsible for the disappearance of *A. swainsonii* from the Bass Strait islands and the reduction of *A. minimus* to its present extremely limited populations on these islands. Because of its limited overall distribution, the scarcity of its habitat and the continuing pressure upon these areas to alter the environment, it must be considered as one of our rare and endangered marsupials whose future welfare should be watched with concern.

PART 7. *Sminthopsis leucopus* (Gray, 1842)

ABSTRACT

In about 6,000 trap nights, set principally for native rats, four *S. leucopus* were incidentally trapped. Two others were hand caught.

The habitat included coastal tea tree, dry sclerophyll forest and beech-dominated rainforest up to an altitude of about 600 metres.

A nest composed of shredded bark and containing three *S. leucopus* was found amongst billets of firewood stacked in the bush. An adult male and subadult female were captured and held in captivity for up to 60 days.

S. leucopus apparently is a rare animal in Tasmania

DISTRIBUTION

The scarcity of Tasmanian specimens of *S. leucopus* and the diversity of habitat in which this animal has been found makes an assessment of its distribution difficult. Over the four year period (1963-1966), when sample trapping was conducted in many areas and habitat types in northern Tasmania, only four were collected from three localities. An additional two specimens came to hand from another locality as a result of woodcutting operations. As shown in the distributional map (figure 13) it has now been collected from both coastal and inland areas. The Queen Victoria Museum holds one male from Binnalong Bay, collected on 9.VI.1963, one male from near Waratah 9.VII.1964, and two subadult females from near Mount Barrow 19.VII.1965. An adult male and subadult female collected from near Holwell on 16.IV.1965 are held in the author's private collection. The National Museum of Victoria has one specimen (reg. no. M4343)

from Clarke Island and two (reg. no. M4584 and M4459) from West Sisters Island (Le Souef 1929). The latter specimen was originally mistakenly determined as *Phascogale flavipes flavipes*. Lord and Scott (1924) give details of a specimen from the Scottsdale district, Sharland (1962) records it from near Maydena, Guiler (1960) states that it has been recorded in recent years from Hawley and Orford, and Mr. Les Hill of Devonport observed and photographed it near Port Sorell. Among the subfossil bone material from the Flowery Gully limestone caves are several maxilla and mandible remains determined by Mr. J. A. Mahoney as of this species or *Antechinus minimus* (pers. comm. A. J. Mahoney; Gill 1968).

HABITAT

The distribution and diversity of habitat in which *S. leucopus* has been collected suggests that it has little or no preference. The four localities from which the author has personally handled animals are all quite different. The specimen from Binnalong Bay was taken by J. W. Swift while sample trapping for rats on the edge of a small brackish lagoon, only a few hundred metres from the coast. The site was an accumulation of logs, tea-tree and sandy soil which had been bulldozed together during clearing operations some time previously. The vegetation nearby was mostly tea-tree scrub and heath which gives way to light eucalypt forest about 100 metres inland. Repeated trapping in the area on several subsequent occasions failed to catch further specimens. The introduced rat *Rattus rattus* was common in the vicinity.

Despite many hundreds of trap nights in the subalpine rainforest only one *S. leucopus* has been taken in this environment. This was in dense beech *(Nothofagus cunninghamii)* dominated habitat near Waratah at an altitude of about 600 metres during a snow storm, with a fall of about 15 cm. already on the ground. The site was at a small rat-like hole in the butt of a large decaying beech stump and in an area where the velvet-furred rat (*R. l. velutinus*), the long-tailed rat (*P. higginsi*) and Swainson's phascogale (*A. s. swainsonii*) are plentiful.

The habitat where the Holwell animals were collected is heavy dry sclerophyll forest dominated by tall *Eucalyptus* spp. and at an altitude of about 300 metres. They were caught by hand when disturbed from a nest of shredded bark built among firewood which had been cut and stacked at the stump some time previously.

Two specimens from near Mount Barrow were trapped on one night in close proximity to each other, in an area of beech rainforest at an altitude of about 450 metres. *P. higginsi* and *R. l. velutinus* were also taken in the same vicinity. The remaining records are from areas of equally diversified habitat. The climate ranges from the mild coastal heathlands and Bass Strait Islands to the subalpine rainforest annually subjected to winter snow falls.

DESCRIPTION

Guiler (1960), Sharland (1962) and Lyne (1967) give abridged descriptions of *S. leucopus*.

The present description is based on the three adults and four subadults which have been collected during the three years 1963 to 1965.

External characters

In general form (see plate 23) *S. leucopus* is lightly built with short legs and a tail shorter than its head and body. Its snout is slightly elongated, with a sharply pointed nose, the general facial appearance being somewhat "fox like." The nostrils are naked and grey, the eyes prominent and situated slightly behind the mid-point between the nostrils and the ears. The iris is dark brown and the pupil black.

The ears are relatively large, broad and rounded terminally with a sparse covering of very short grey and brown hair over a grey skin. A slight tuft of hair of a similar colour to that on the cheeks, is present on the anterior edge of the ear laterally adjacent to the tragoid notch. The upper surface of the feet is sparsely covered with short white hair.

The toes of the front feet are stout and equipped with claws which are sharp but only slightly curved and generally lack pigmentation. The digital formula is 3>2 = 4>5>1. There are four prominent interdigital pads, a prominent outer metacarpal pad and a small inner metacarpal pad. The outer and inner metacarpal pads are weakly striated while the interdigitals and the remaining naked surface of the manus is strongly granulated. These features are less obvious in the subadults.

The first toe of the hind foot is greatly reduced and rudimentary. It lacks a nail and terminates in a naked pad. The remaining four toes are elongated with sharp slightly curved claws which may have a pale brown pigmentation. The hairs which erupt from near the base of the claws may reach beyond the end of the claws. The digital formula is 3>4>2>5>1 though there is little difference between 2, 3, 4, and 5. The first interdigital pad is situated near the base of the first digit and is small, smooth and inconspicuous. The remaining three interdigital pads are prominant. All are weakly striated on the apex and surrounded by strong granulations which extend over the remaining naked surface of the pes.

A narrow ridge covered with white hair divides the upper half of the naked pes. It originates near the inner edge of the heel and tapers to terminate laterally adjacent to the first interdigital pad. At its terminal point is a large granulation which appears as a rudimentary outer meta-tarsal pad.

The tail is covered with bristle-like hairs about 1.5 mm. long. On the dorsum they are mostly black, the laterals being brown with a black terminal band while on the ventrum they are white. Those on the extreme tip may be slightly longer than on the rest of the member.

The nipple complement has been indecipherable as only subadult females were available. One of these, collected on 18th August, was found to possess at least eight faintly developed nipples.

The scrotum is pendulous and covered with hair of the same colour as, though somewhat shorter than, that of the belly region.

Pelage

The fur is soft and dense reaching to 10mm. on the dorsum, 9 mm. on the flanks and 8 mm. on the ventrum. The guard hairs are inconspicuous and reach to 3 mm. above the main pile. Those on the dorsum are entirely black, on the flanks they are white with a black subterminal band and on the ventrum they are entirely white. The terminal half is thick and robust tapering to an extremely fine tip. The basal half is finer and less robust.

The main body pile is a leaden grey for most of its length. On the dorsum there is a pale tan subterminal band with the extreme tip black. This becomes progressively paler on the flanks and on the ventrum the terminal region is entirely white.

The composite effect is dark grey dorsally becoming paler on the flanks and a very pale grey ventrally. In some individuals the facial region appears slightly browner due to the subterminal tan band being darker and more extensive.

Lyne and McMahon (1951) give some details of the surface structure of the hair.

No attempt has been made to assess the number or position of vibrissae. Lyne (1959) illustrates the facial vibrissae of a specimen (Tas. Mus. 568) and gives the following vibrissae distribution for the species. Mysticial 4, 7, 7-8, 8 (vibrissae below row four not included), genal 8-9, supraorbital 2, interramal 4, submental 3?, ulnar carpal 1-3, medial antebrachial 1, (two to three submentals were present in the adults examined by me). The mysticial are the longest and most prominent, reaching to 25 mm. Colour ranges from black to white but generally blends with that of the accompanying pelage.

Plastic dimensions

Plastic measurements were taken as described in part 5. Because of the few specimens available the details of each is given in table 25.

Skull

The measurements given in table 26 were made with slide calipers graduated to one tenth of a millimetre, in the same manner as illustrated by Wakefield and Warneke (1963). Because of the few specimens available the details of each is given. The fontanelle was fully ossified and the adult dental complement was complete in each specimen. No abnormal tooth wear was apparent. The dental formula is $I\frac{4}{3},C\frac{1}{1},PM\frac{3}{3},M\frac{4}{4}$. The central pair of upper incisors are set well in advance of the adjacent members. They are slightly longer but do not protrude. The posterior upper premolars are large and stand above the rest of the tooth line. The lower canines are small and barely exceed the adjacent members.

MISCELLANEOUS OBSERVATIONS

In captivity

An adult male and a subadult female (see plate 23), collected together in a nest near Holwell on 16.IV.1965 were kept in captivity for 28 days and 60 days respectively. They were always alert with a timid, defensive disposition. When handled they would bite vigorously, holding on for some seconds, but rarely with sufficient strength to inflict a bleeding wound. They showed no tendancy to tame and would attempt to escape at every opportunity. Most of the day they spent huddled in a rough nest in the corner of the cage.

Natural retreats

It appears from trapping and observations that *S. leucopus* has its nest retreat in a hole in rotting timber or similar such cavities. The animal trapped at Binnalong Bay was taken beneath a pile of bulldozed logs and rubbish. The Waratah animal was trapped at the entrance to a rat-like hole in the side of a large decaying stump. The two from near Holwell were found in a rough nest composed of

Reg. No.	Age	Sex	Weight (gm.)	Head & Body (mm.)	Tail (mm.)	Ear (mm.)	Pes (mm.)	Scrotum (mm.)	Testes (mm.)	Locality	Date
1963/1/149	Adult	Male	-	108	88	17	19	20x15	10x8	Binnalong Bay	9.VI.1963
1964/1/228	Adult	Male	30	112	92	19	20.5	17x15	12x8	Waratah	9.VIII.1964
14565	Adult	Male	-	116	97	21	21	12x12	8x6	Holwell	14.V.1965
1965/1/157	Subadult	Female	18	93	84	18	18.5	-	-	Mt. Barrow	19.VIII.1965
1965/1/158	Subadult	Female	13.5	86	76	17.5	17.5	-	-	Mt. Barrow	19.VIII.1965
15665	Subadult	Female	-	89	79	17	17.5	-	-	Holwell	15.VI.1965

TABLE 25. DETAILS OF SIX *S. leucopus* COLLECTED DURING THE STUDY PERIOD.

Reg. No.	Basalar length	Zygomatic breadth	Postorbital constriction	Palatalar length	Anterior palatine foramen	Alveoli length M^{1-3}	Breadth at M^3
1963/1/149	25.4	14.7	5.8	14.1	3.3	4.6	8.4
1964/1/228	25.4	-	6.2	14.0	3.5	4.6	8.3
14565	27.3	15.6	6.2	15.3	3.7	4.6	8.7
1965/1/157	22.9	12.5	5.3	12.6	3.6	4.3	7.5
1965/1/158	22.2	12.3	5.3	12.7	3.5	4.2	7.0
15665	23.4	13.2	5.4	13.2	3.7	4.3	7.6

TABLE 26. CRANIAL MEASUREMENTS (in millimetres) OF SIX *S. leucopus* COLLECTED DURING THE STUDY PERIOD.

shredded stringy bark placed in a narrow space in the middle of fire wood stacked in the bush. This nest was said to have three animals in it but one eluded capture. Similar nests in similar sites with animals in them have been seen in the vicinity on other occasions (pers. comm. J. G. Hodge). The two trapped near Mt. Barrow were taken in beech rainforest where rotting timber was abundant (pers. comm. J. W. Swift).

Mr. Les Hill informed me that he observed and photographed one which was living in a hollow log near Port Sorell. It was attracted outside for photography with pieces of raw meat.

Sharland (1962) records three found in a substantial nest of shredded bark 45 feet up in the side of a gum tree near Maydena.

Food

No gut contents have been available to determine natural foods. In captivity they were found to eat raw meat, small lizards and insects without apparent preference.

Trapping

Of the four animals taken in traps, one was in a Sherman box trap, described in part 5 and three in breakback rat traps. Bait in each instance was bread and there was no proof that any of the four had attempted to eat the bait. It appeared probable that they had been trapped accidentally or as a result of curiosity. No trapping was undertaken for *S. leucopus* specifically and the four specimens were taken while trapping for small mammals in general and rats in particular on about 6,000 trap nights in the three years 1963 to 1965.

Parasites

Fleas and mites were collected from the Waratah specimen on 9.VIII.1964 and ticks were collected from both the Mt. Barrow specimens on 19.VIII.1965. All have been lodged with the National Insect Collection, Canberra. The fleas have been determined by Dr. G. M. Dunnett as *Acanthopsylla ? rothschildi*.

Natural enemies

There is nothing to suggest other than normal predatory pressure on *S. leucopus* and it can be reasonably assumed that it is subjected to the same natural enemies as are the other small dasyurids (see parts 5 and 6). The scarcity of captures despite the fairly extensive trapping in a range of habitats suggests that it is rare and much more sparcely distributed than any of the small mammals dealt with in the former parts of this series. Its distribution in a wide range of habitat, from the warm coastal regions to the subalpine rainforests, must provide a safeguard against future threats from land utilisation and man-made habitat changes. However, the pattern thus far also suggests that it may be a relict species with small colonies surviving in scattered localities. Much remains to be learnt about the population and distribution of this small dasyurid. The lack of information available at present obscures the reason for its rarety in what appears to be a suitable environment.

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ADDENDUM

On 11 October 1970 a female *S. leucopus* was caught alive near Round Hill about one mile north of Binnalong Bay. It had been flushed from a nest, composed of shredded bark and leaves, placed behind the lining in an old abandoned bus. It was passed to the Queen Victoria Museum and lived for ten days in captivity. During this period it appeared active and healthy and fed regularly on live insects and raw meat. Its death was not preceded by any ailment. Upon subsequent examination it was found to be carrying a full complement of eight pouched young of a crown/rump length of 12 mm. The female and young have been preserved in spirit (reg. no. 1970/1/4).

On 24 October 1971 an adult male in an advanced stage of decomposition was received at the Queen Victoria Museum. It was stated by the donor to have been brought home by his cat and left on the door step of his suburban home in Emu Heights, Burnie. The specimen has been preserved in spirit (reg. no. 1971/1/3).